



Space Technology 5

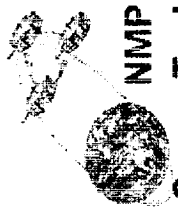
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# **Power System Electronics Accommodation for a Lithium Ion Battery on the Space Technology 5 (ST5) Mission**

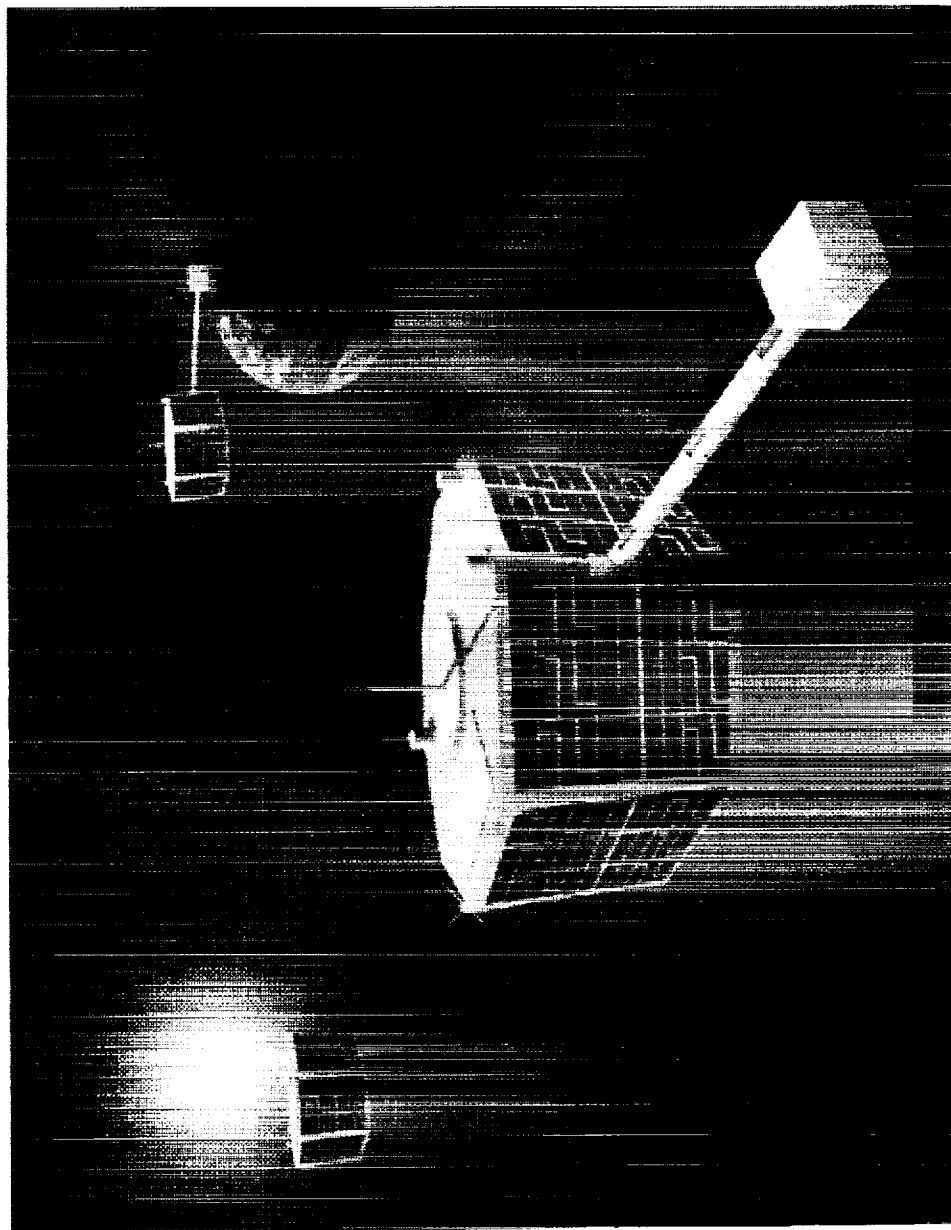
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# Space Technology 5 Constellation

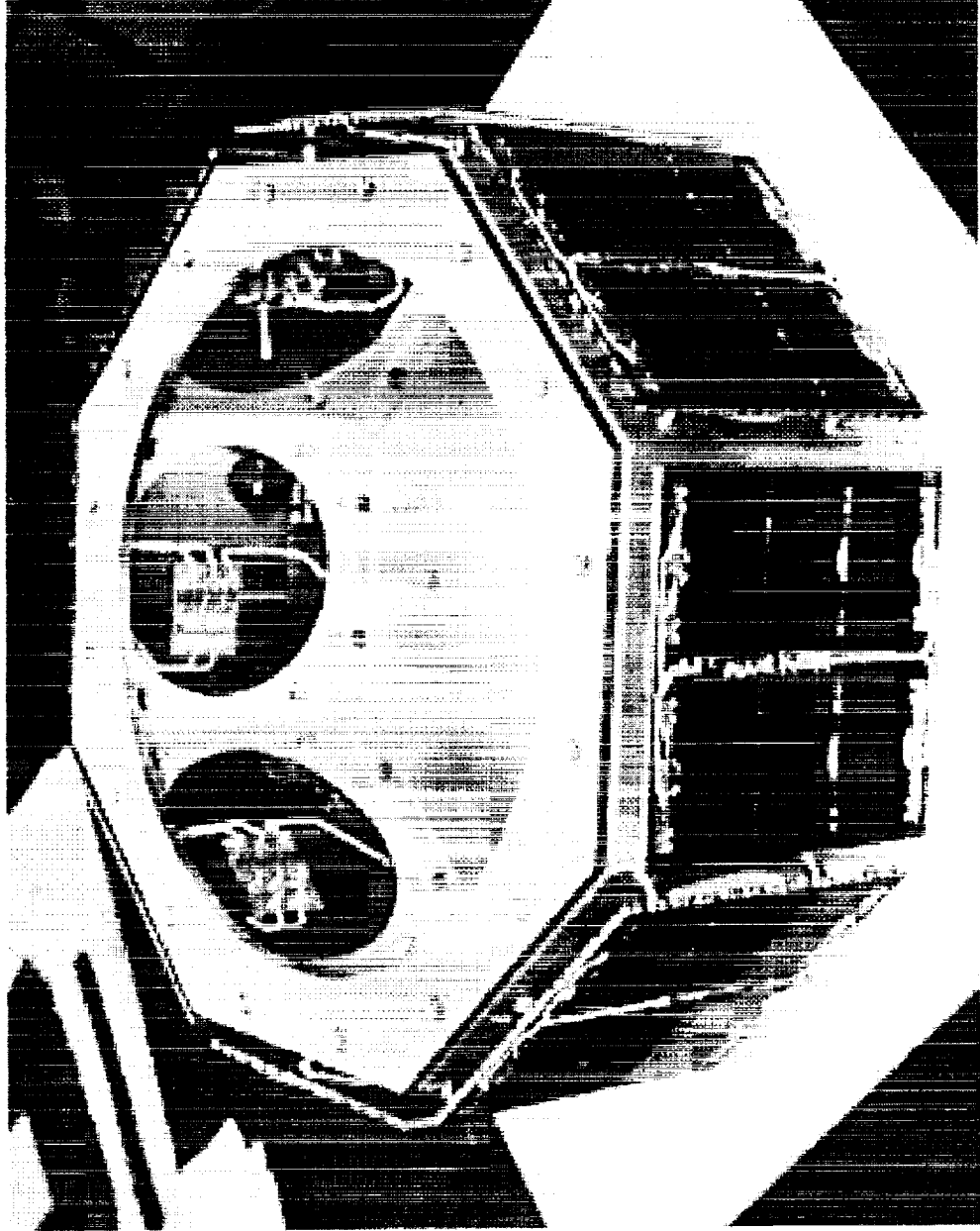


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# Photo of ST5 Nanosat Model





# Original Concept for Li-ion Accommodation on ST5



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- ◆ Use Large Amp-hour cells (Approx. 5Ah)
- ◆ Electronics required to provide functions at the cell level:
  - Individual Cell Charge Control
  - Individual Cell Protection
  - Individual Cell Monitoring
- ◆ Original design included:
  - Individual Cell Charge Control
    - Independent cell chargers -- Voltage taper
  - Individual Cell Protection
    - Overcharge protection-- Voltage clamp, Cell bypass
  - Individual Cell Monitoring
    - Voltage, Temperature monitoring for each cell
- ◆ Resulting electronics grew in mass, complication in order to satisfy cell level requirements
- ◆ Concerns over reliability:
  - additional electronics
  - failure of large amp-hour cell



# ST5 Electrical Power System-- Original Concept

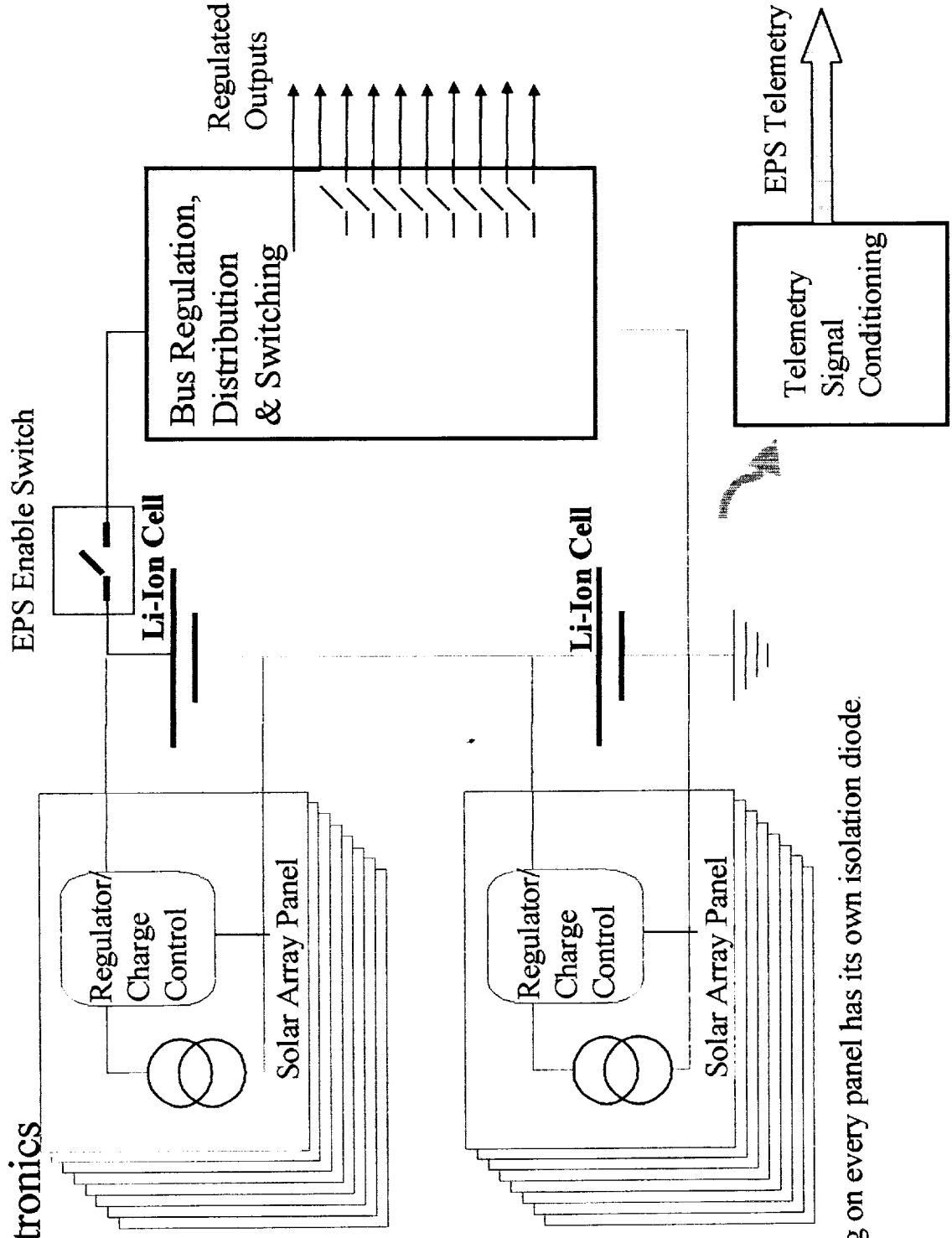


NMP

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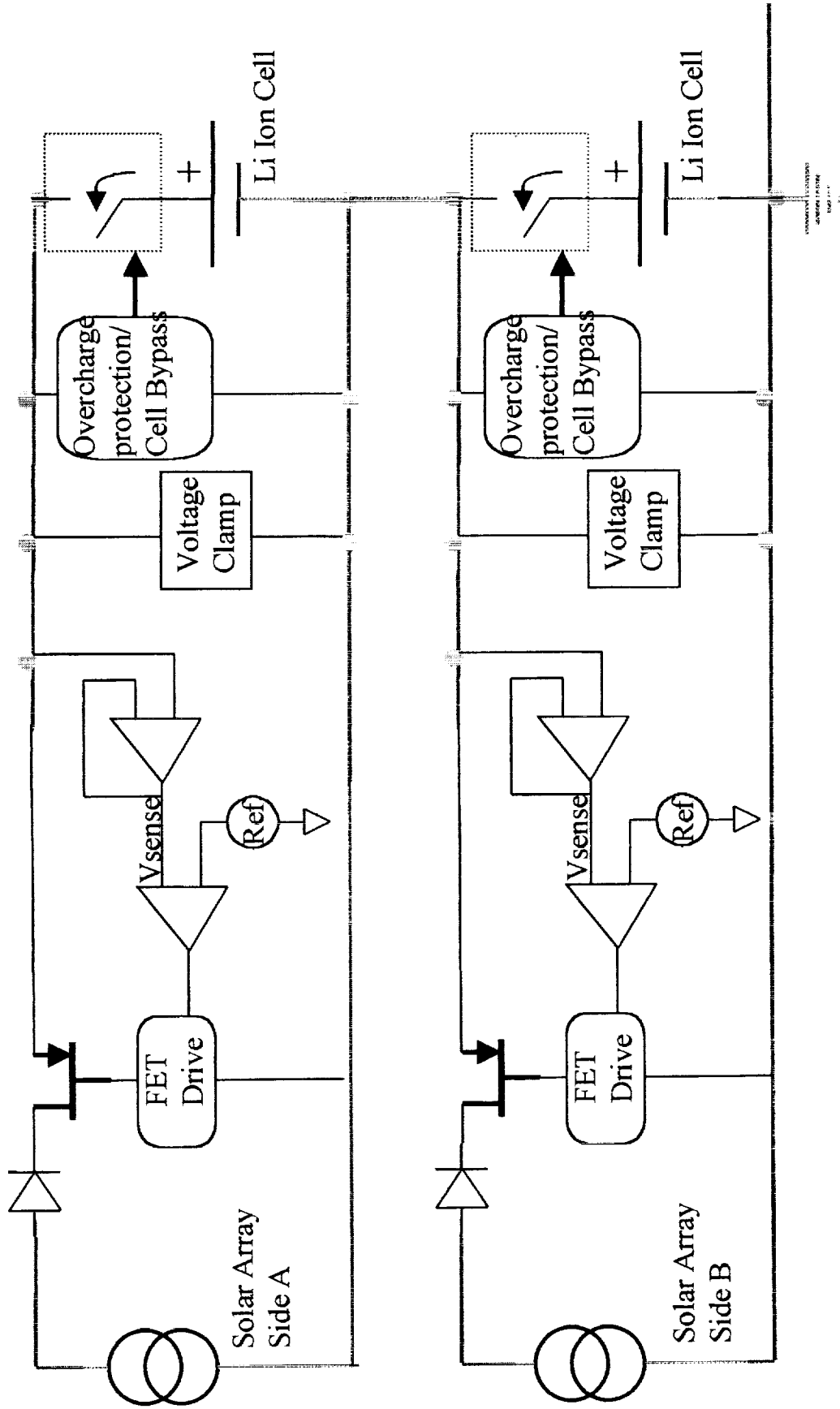
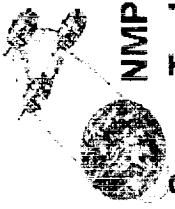
## •Cell Level Electronics

Solar Array:  
Triple Junction Cells  
2 Circuits  
8 Panels





# Simplified Electronics Diagram-- Cell Level Electronics





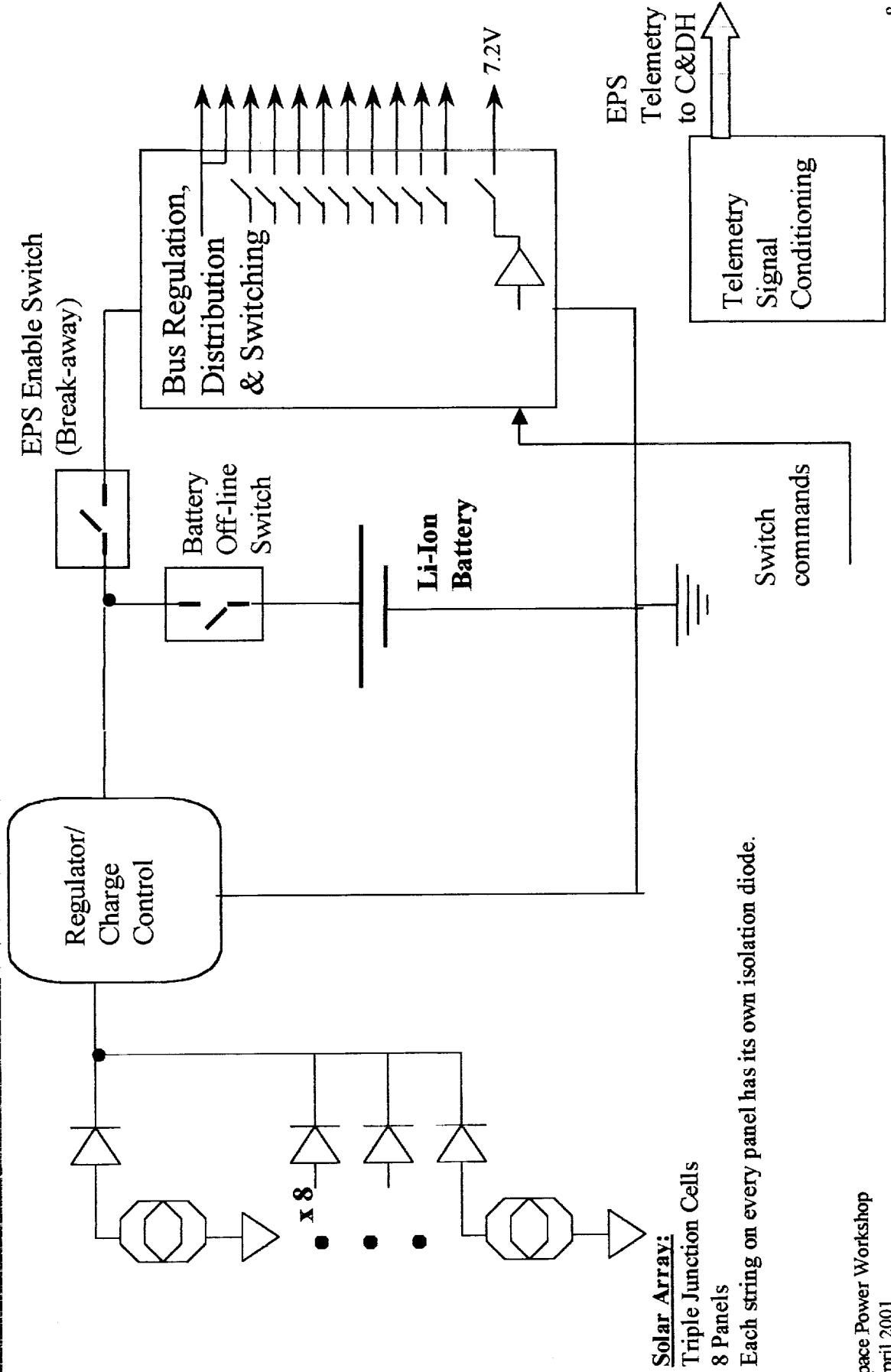
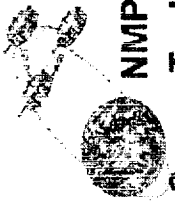
# Revised Design with Optimized System Mass



- ◆ Uses smaller amp-hour size cells (18650, 1.5Ah)
- ◆ Screened and well-matched cells
- ◆ Electronics required to maintain battery are at battery level:
  - Battery level charging-- (Voltage taper)
  - Battery level overcharge protection-- voltage clamp, no bypass
  - Battery level monitoring for control
- Cell level monitoring for information only
- ◆ Lowers system mass
- ◆ The result is an increase in reliability
  - Reduction in circuit complexity
  - Cell failure would have smaller impact on system



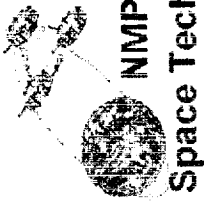
# Present Design Concept-- Battery Level Control



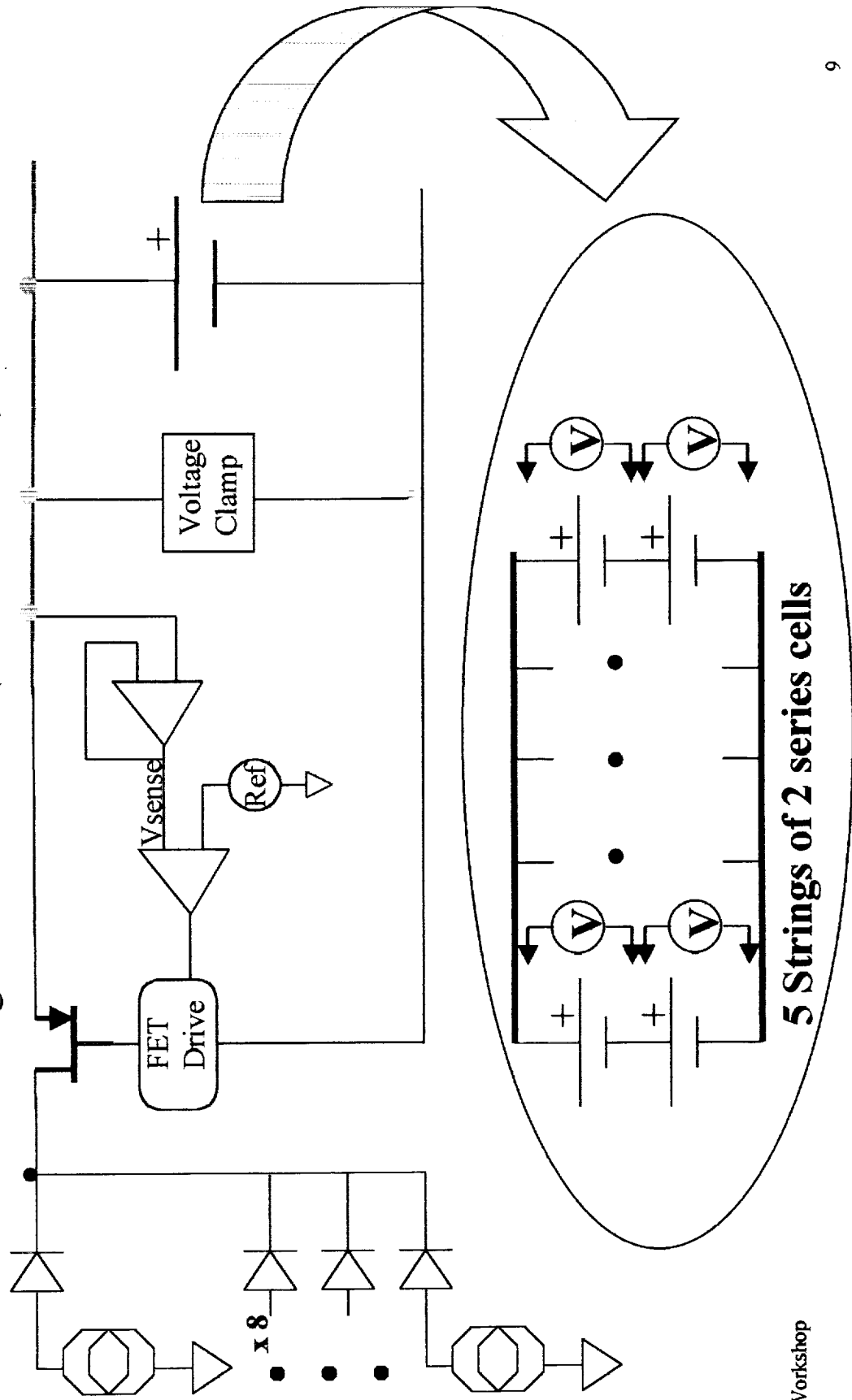




# Simplified Electronics Diagram-- Optimized System Mass

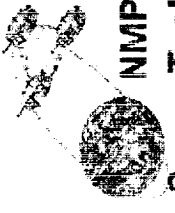


- Charging at the Battery level
- Monitoring at the Cell level (for information)





# Conclusions/Comments



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- ◆ ST5 mission requirements include validation of Lithium-ion battery in orbit.
- ◆ Accommodation in the power system for Li-ion battery can be reduced with smaller amp-hour size, highly matched cells when compared to the larger amp-hour size approach.
- ◆ Result can be lower system mass and increased reliability.